Weatherwise

Experiments With Cloudy Skies

New York's Snowburst

Armed Forces Weather Reserve Projects

How to Make Snow Crystal Imprints

Malden High School Weather Bureau

Aurora Ahoy!

Vol. I, No. 1

FEBRUARY, 1948

"SOME PEOPLE ARE WEATHERWISE BUT MOST ARE OTHERWISE" — BENJAMIN FRANKLIN

WEATHERWISE

THE MAGAZINE ABOUT WEATHER

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Local Weathermen

EVERY COMMUNITY needs a weatherman. The complexities of modern life have shown again and again the need for considering the weather factor in almost all human activities. The community that lacks the advice and services of a trained weatherman is handicapped in meeting everyday problems.

At the present time the United States Weather Bureau maintains either a regular or a co-operative observing station in about 5,500 locations. Thus there are less than two observation posts per county in the United States. This compares to some 9,000 thunderstorm observers in prewar Germany, an area then about two thirds the size of Texas.

Maintenance of climatic records is the first duty of the local weatherman. But there are many other related activities in which he may be of service. Newspapers need data; radio stations need commentators; clubs and camps need lecturers; flight schools need instructors; and business and industry need consultants. These activities may be carried on as a hobby or part time, and in many cases they may be very remunerative.

Our country, too, needs more weathermen. Our unpreparedness in 1941 was very evident in the field of meteorology. Only a small handful of trained observers and forecasters were available then to meet the demands that eventually required an army of 25,000 meteorologists. To meet the increasing world-wide demands on our armed forces many hundred new weathermen every year are needed.

It is one of the prime purposes of the Amateur Weathermen of America to see a trained weatherman in every community, so that the weather factor may be dealt with intelligently. We also hope to see a large reserve pool of trained weathermen available in case another national crisis should face us in the years ahead. WEATHERWISE plans a series of articles showing how many individuals are already serving their community and their country through weather work. D.M.L.

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Cover: An activity in the Naval Reserve weather training program: Seventeen-year-old seniors at Los Angeles High School obtain practical weather experience at Naval Air Station, Los Alamitos, Calif., prior to studying meteorology in college. Both young men are Apprentice Seamen in the organized reserve. (See page 6.)

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General, circulation, and advertising offices: Franklin Institute, Philadelphia 3, Pa. Unsolicited articles and pictures are welcome, but prompt editorial attention is not guaranteed, and unsolicited manuscripts must have return postage provided by the author.

Supercooled water in various forms on the top of Mt. Washington, N. H., photographed by the author in January, 1945, during the first phase of his study of snow clouds. The picture shows rime formation, an orographic valley cloud, a stratocumulus deck with snow falling, and altostratus.

Experiments With Cloudy Skies

VINCENT J. SCHAEFER, GENERAL ELECTRIC RESEARCH LABORATORY

AS MAN becomes more urban in his activities, he tends to surround himself more and more with artificial weather. Such things as air conditioning, central heating, improved lighting, refrigeration systems, and other methods of local "weather" control have made some persons partly immune from the vagaries of natural weather. I say partly, because if the power lines go down due to an ice storm, or the hydroelectric plants shut down from lack of rain in the upper watersheds, or if the cost of sirloin steak climbs into the higher price brackets due to a lack of cattle food in a drought-plagued Middle West, the city dweller is still affected by the weather.

It is not surprising, therefore, that widespread and popular interest occurs when someone climbs into a small plane with a few dollars worth of gasoline and dry ice, flies into a cloud and shows that a profound change can be produced in it. When done properly, streamers of snow or curtains of rain often develop in the affected regions.

Unfortunately, however, as often happens when scientific studies have a popular appeal, exaggerated claims, fantastic implications, and unsound experimental activities accumulate in rapid succession to confuse the true picture.

In summarizing the first year of activity in the field of cloud modification, it is best to review briefly the basic factors which seem to be of importance if any effect is to follow the introduction of dry-ice pellets into a cloud.

First of all, at least a part of the cloud must consist of liquid water droplets colder

than 0° C. Wherever such supercooled droplets exist, it is a simple matter to produce large numbers of ice crystals in that region. It can be shown quantitatively in the laboratory that a pellet of dry ice the size of a pea is capable of producing at least 10^{16} ice nuclei. Whether all or only a minute fraction of these grow to snow crystals when introduced into a cloud depends on such things as the available moisture, the convection in the air, the efficiency of dispersal of the nuclei, and similar factors. To emphasize the tremendous numbers of nuclei which are available when a dry-ice pellet is introduced into a supercooled cloud, note that if each of the 10^{16} ice nuclei grew to the size of a small snow crystal they would amount to 300,000 tons of snow!

If any appreciable precipitation is to fall from a seeded cloud, a number of favorable conditions must be present. For example, unless the humidity of the air below the cloud is fairly high, the precipitation may evaporate before it reaches the ground. And, of even greater importance, there must be a continuing supply of moisture flowing into the affected region to continue the precipitation, for there is only about 0.15 inches of condensed moisture in an average cloud having a vertical thickness of a mile.

A sober realization of these and similar facts emphasizes the point that much work must be done before more than local showers can be produced by man using dry ice or any other material in the clouds of the atmosphere. Unfortunately, when rain is needed to relieve a drought condition, there is often nothing but day after day of cloudless skies over the affected region. However, it should be mentioned in about the same breath that sometimes it should be possible to trigger off a considerable shower from a towering cumulus before the precipitation cycle develops by natural processes. It should be possible, at times, to initiate the development of a snow or rain storm at a specific location when nature permits the development of a large area of supercooled clouds.

The following is a partial list of experiments conducted during the past year which I feel are representative of the general advances made in cloud modification.

November 13, 1946 — Initial experiment by the author over Berkshires in Massachusetts, converting a four-mile supercooled stratocumulus cloud into snow flurries using six pounds of granulated dry ice.

November 21, 1946 — Conversion by the author of supercooled ground fog to snow crystals by seeding with dry ice. Schenectady, New York.

December 20, 1946 — Production of snow by R. Smith-Johannsen in supercooled orographic cloud on summit of Mt. Washington, New Hampshire. Seeding with liquid CO_2 from tower of Mt. Washington Observatory.

An L-shaped hole produced by dry-ice seeding in a supercooled layer of clouds. The dimensions marked are in miles. The freedom from icing conditions in such a hole should permit easy descent for airplanes. U. S. Army Signal Corps photograph.

December 20, 1946 — Production of extensive snow area by the author in supercooled stratus cloud by seeding in base of supercooled overcast with dry ice and liquid CO_2, in region north of Mohawk Valley in New York.

February 5, 1947 — E. B. Kraus and P. Squires. Production of rain in stratocumulus by seeding supercooled cloud at 23,000 feet with dry ice, and detection of effect by radar 100 miles east of Sydney, Australia.

February 6, 1947 — Production of snow by R. E. Falconer and V. F. Clark in supercooled orographic cloud at 6,200 feet, using silver iodide flare. Mt. Washington, New Hampshire.

April 4, 1947 — Colonel E. S. Ellison and L. R. Richards. Production of rain in supercooled stratus cloud at 10,000 feet in Oregon.

April 7, 1947 — Personnel of Project CIRRUS. Joint Army-Navy-Air Forces-General Electric project produced 45-square-mile geometric hole in supercooled stratus cloud over Adirondack Mountains in New York, to obtain quantitative information on effect of dry-ice seeding methods.

July 16, 1947 — A. Hoff and H. L. Mott. Production of rain from cumulus cloud near Phoenix, Arizona, by seeding cloud at 20,000 feet with dry ice.

September 23, 1947 — Production of rain at 9,500 feet by L. B. Leopold and M. Halstead in above freezing cumulus cloud using dry ice over island of Molokai in Hawaiian Islands. Results interpreted by Dr. Irving Langmuir as start of chain reaction in new precipitation theory advanced in paper delivered before the National Academy of Sciences, November 17, 1947.

October 13, 1947 — Personnel of Project CIRRUS in dry-ice seeding flight and cloud study of hurricane "King," 350 miles east of Jacksonville, Florida, at 25,000 feet.

September-October, 1947 — Production of snow and rain by C. L. Chipman and G. G. Sampson in vicinity of Prosser, Washington, in series of flights.

October-November, 1947 — Series of experimental flights over western Kansas by C. Barhydt and J. Berkeley, producing snow and rain areas.

Many other experiments might be listed, but it is believed that the above examples illustrate some of the significant advances in techniques and materials during the past year. The list indicates the widespread and active interest that has developed in the general subject. Many experiments have been carried out in other countries which have not yet been re-

(Continued on page 18)

New York's Snowburst
December 26, 1947

JOHN DROHAN

A LIGHT SNOW started at 5:30 a.m. and continued until 8 a.m., when it became moderate with the wind holding northeast. Heavy snow started at 10:30 a.m. and continued until 7 p.m. The wind increased from 8 m.p.h. at 6 a.m. to 45 m.p.h. at 3 p.m. The barometer fell from 29.76 at 6 a.m. to 29.37 at 9 p.m.; then it started up slowly.

Snow piled drifts from three feet to five feet in some places. Only a few streets are plowed, the snow packing four to six inches on plow racks. Other streets are closed, and where I live it will be two or three days before the plow will be able to get here because of drifts four feet deep all the way down the middle of the street. The sizes of snowflakes were small and medium; the dense sky was obscured by the snow all day. Between 2 p.m. and 3 p.m. visibility was reduced to less than 25 feet, just like a fog. It was the heaviest snowfall in 24 hours (32 inches) and also in one hour, six inches from 2 p.m. to 3 p.m. I took pictures of the snowstorm and will send you some of them when they are developed and printed.

HEAVIEST SNOWFALL IN THE HISTORY OF WHITE PLAINS, N. Y.

Time	*Temp.*	*Barometer (inches)*	*Wind Direction and Speed (m.p.h.)*	*Snow on Ground (inches)*
6 a.m.	23° F.	29.76	N 8	1.0
7 a.m.	23°	29.73	N 10	1.7
8 a.m.	25°	29.70	NE 12	2.5
9 a.m.	26°	29.66	NE 10	3.0
10 a.m.	27°	29.63	NE 10	4.0
11 a.m.	27°	29.60	E 15	7.3
12 noon	29°	29.59	ENE 18	12.4
1 p.m.	29°	29.57	NE 25	13.7
2 p.m.	28°	29.50	NE 38	14.6
3 p.m.	27°	29.45	N 45	20.9
4 p.m.	26°	29.41	N 36	23.1
5 p.m.	22°	29.40	NW 33	25.5
6 p.m.	21°	29.39	NW 30	26.3
7 p.m.	25°	29.39	NW 25	27.0
8 p.m.	26°	29.39	N 30	27.3
9 p.m.	26°	29.37	NE 30	28.6
10 p.m.	27°	29.41	N 28	29.1
11 p.m.	26°	29.40	NE 30	29.9
12 mid.	25°	29.44	NE 30	31.2
Dec. 27, 1947, the snow ended at 4 a.m.				
5 a.m.	25°	29.49	N 25	32.3

Interesting facts: A halo was seen on Christmas night at 10 p.m., and lightning occurred between 8:45 p.m. and 9:30 p.m. on December 26th. The snow ended at 4 a.m. on December 27, 1947.

9 Roosevelt Street
White Plains, N. Y.

Armed Forces Active Duty Weather Reserve Projects

THE ARMY PROGRAM

DURING the fiscal year 1948, Air Weather Service monitored a successful active duty reserve program, having been offered a training quota of 300 officers by the Air Defense Command. Approximately 2,000 reserve weather officers were queried as to their desire to participate in the program, with the choice of any 15-day period in the interval July 7 to October 31, 1947, and also a choice of any Air Force weather station in which to receive their training. All reserve officers not included for this year's program will be queried next year.

Approximately 40 per cent of those queried this year desired training; of these a sufficient number of names to fill the quota of each Air Force were designated as principals and all additional names were submitted as alternates. Those who applied but did not receive the training will be given first preference in the anticipated program in the next fiscal year.

Continental Weather Wing at Tinker Field, Okla., was directed to implement the training program. Although the training was general in nature this year (almost entirely restricted to routine station work), it is planned that some specialized training will also be included in the future.

The 15-day tour of duty this year included six days of refresher weather training, weather administration, and six days of active duty tour in the weather station. Complete statistical results of the program are not yet available, but from early indications it is apparent that training and reorientation valuable to the reservists and Air Weather Service were accomplished.

THE NAVY PROGRAM

(See front cover)

AT THE CLOSE of World War II more than 1,000 Naval Reserve Aerologists and approximately 8,000 Aerographer's Mates returned to civil life. Less than 10 per cent of this group is presently engaged in a civilian occupation involving meteorology.

It takes three years to train a competent Aerologist and at least six months to train a competent Aerographer's Mate. Anticipated needs in the event of a future national emergency require rapid mobilization to full wartime strength. In the light of the above circumstances, and as a result of the increasing demand in modern naval warfare for weather information, the following ambitious reserve training program is being undertaken in order to maintain a reserve pool of competent aerological personnel:

Active Duty Reserve

1. A few billets have been established for both aerological officers and enlisted men in each of the Naval Air Reserve training stations for personnel on active duty, the purpose of which is to provide weather information to reserve pilots and to administer the Naval Reserve program for aerological personnel. For information contact the commanding officer at the nearest Naval Air Reserve station.

Aerological Component of Organized Reserve

1. Naval Air Reserve training bases throughout the nation are providing facilities for weekly training periods in an operational weather unit as well as the opportunity to observe weather phenomena in flight.

2. This training is usually set up on a bimonthly basis for which the trainee receives four days' pay per month commensurate with the rank or rate he holds.

3. In addition, personnel in the organized reserve are ordered to two weeks' training duty each year for which they receive pay, allowances, and travel expenses.

4. Billets are available for both officers and enlisted personnel. For enrollment contact the aerological officer at the nearest Naval Air Reserve training base.

Aerological Component of the Volunteer Reserve

1. The volunteer reserve provides training for those who cannot participate in the organized reserve.

2. Two weeks' training at a naval aerological activity with pay and allowances can be had by applying to the commandant of the home naval district.

3. Periodic summaries of new developments in naval aerology are being mailed to interested parties.

4. Plotted unanalyzed weather maps are made available for home analysis.

5. A correspondence refresher course is being prepared for officers to be made available at a future date.

General Information

Only former reserve aerological officers are eligible to participate in the reserve aerology program for officers.

Weather observers from every service — Navy, Army, Marine Corps, and Coast Guard — are eligible for enlisted billets. Veterans holding a rate other than Aerographer's Mate can be reclassified upon satisfactory completion of standard requirements.

Non-veterans between the ages of 17 and 35 years are eligible also, provided they meet minimum health and mental requirements for acceptance as Apprentice Seamen in the U. S. Naval Reserve.

For further information on the aerological component of the United States Naval Reserve, write to Op 55F-4, Chief of Naval Operations, Department of Navy, Washington, 25, D. C.

How to Make Snow Crystal Imprints

HANS NEUBERGER, PENNSYLVANIA STATE COLLEGE

FEW OF US who live in a climate with winter snow can escape the fascination of the fragile beauty and endless variety of the white diamonds falling from the sky. The collection and preservation of snow crystal patterns may become an informative hobby.

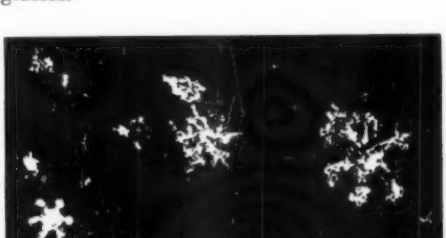
Photomicrography of snow crystals, though most exact, is rather expensive, and necessitates working outdoors in subfreezing weather, as does the making of plastic replicas. However, if one is willing to sacrifice fine structural detail of the crystals for simplicity, low cost, and convenience, there is an easy method for recording imprints of snow.

The materials needed for this method are: glass, cellophane, or smooth white cardboard; a kerosene lamp or candle; a thin solution of shellac in alcohol, or commercial fixative purchasable at stationery or artist's supply stores.

The cardboard is blackened with soot by moving it back and forth through the slightly smoking kerosene or candle flame. Avoid heating the surface as otherwise the soot adheres to it too firmly. The most effcient thickness of the soot layer is best determined by trial and error.

The sooted surface is then briefly exposed to falling snow crystals which will leave visible imprints on it. It should be noted that when the crystal, deposited on the soot, is allowed to melt too rapidly, the imprint is liable to be smudged by the melt-water contracting into a droplet. Finally, careful dipping into shellac preserves the record.

For lantern slide projection, the crystals may be caught directly on a slide cover glass prepared as described above, or on cellophane which is then mounted between two cover glasses.



Snow crystal imprints made by the method described here. The single flake in the upper picture is magnified eight times.

MALDEN HIGH SCHOOL WEATHER BUREAU

ANNE F. SLATTERY
MALDEN HIGH SCHOOL

DURING the past five years, Malden High School has proven that meteorology is a worthwhile course for senior high schools. It is scientifically sound, very timely, of practical value and cultural worth, great fun, furnishing students with a lifetime hobby. Meteorology enhances native intellectual curiosity and guides it into important channels.

Our bureau is conducted by the students themselves with just as little advice and guidance as possible. From each class of juniors we select a weather bureau staff consisting of a chief meteorologist, an assistant chief, observers, recorders, a public relations man, a radio recorder, and a supervisor of instruments and balloons. Their duties extend from December to December of the senior year and each graduating staff member trains his successor before he leaves.

We are especially fortunate in our physical setup. Our huge flat roof, facing all points of the compass, leads out of two excellent classrooms, so that the classes can easily step out on the roof to study clouds, low ceilings, wind shifts or thunderstorms, in nature's laboratory. One of these rooms we use for the workshop of the weather bureau. In this room we have a long table with an adjustable top, equipped with all the paraphernalia for the making of weather maps. We have wind instruments, a short-wave radio with which we can get weather reports from all over the country, a helium tank and ceiling balloons, and the like. Each year some new instrument is added by gift or purchase, or from the graduates. We now possess all necessary instruments but a theodolite.

It is truly a co-operative project. The shelter for our instruments was made according to government specifications by the manual training students. The trade school electronics class installed all the weather instruments, including the anemometer and weather vane. One wartime graduating class gave us 150 dollars for a standard wind recorder and counter.

Our records are complete since January, 1942, these activities supporting our proud claim to recognition as an amateur weather observer for the U. S. Weather Bureau.

The workshop is by no means the whole course, however. We have 150 lessons in meteorology each year, using as a basic text Petterssen's *Introduction to Meteorology*. The course includes such subjects as evaporation, condensation and precipitation, stability and instability with use of the adiabatic chart,

Students analyzing a synoptic map. All photos by William P. Morgan.

temperature variations, structure and stratification of the atmosphere, wind systems, air masses and fronts, special storms, and forecasting by projecting the map of three previous days, and the reports from the radio broadcasts. Each student must take all observations for five successive days during his course, must make 10 weather maps, and learn to receive and send teletype messages in code.

We make great use of balloons to prove what we study and to observe wind, turbulence, ceiling changes, and so forth. Once a year we send up an anchored pilot balloon with a maximum-minimum thermometer actually to observe lapse rates in temperature. Our free balloons are tagged with a request for the finder to return the tag or balloon remnants with a notation as to when and where it was found. These we check with atmospheric conditions of the day and hour it was sent up. Our longest trail led to the New Brunswick woods during the recent forest-fire scare. At present we are perfecting an instrument of our own to determine the freezing level by balloon ascension. We follow every threat of a hurricane by a stand-by watch until all danger of it is past. In 1944 we stayed in the workshop all night and charted the storm until it was over.

The course is real work and fun for students who take a definite interest. We have had several girls who are preparing to become air hostesses, or hope to be forecasters one day. The staff members have a gold pin designed by a student to help keep them in touch with each other, and these are worn in many parts of the world. Each year the staff holds open house for the faculty that they too may understand the working of the bureau. We furnish a forecast upon request from the superintendent or any member of the faculty, and we have even co-operated in the matter of no-school signals. Once a year the staff itself visits Blue Hill Observatory and the Logan Airport.

A demonstration by a student in the weather class at Malden High School.

Come and visit us. We shall be very glad to show our project to students of other schools, to teachers, or to anyone interested in weather. We would like very much to hear from any other high schools that study weather — either by direct communication or through the pages of WEATHERWISE. Our address is Malden High Weather Bureau, Malden High School, Malden 48, Mass.

AURORA AHOY!

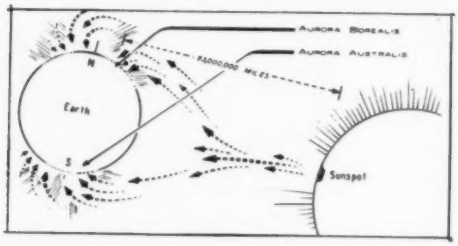
ERIC SLOANE

ILLUSTRATED BY THE AUTHOR

THE STORMS that most people are familiar with are wet ones. And because there is no moisture in the upper stratosphere we talk of it as being entirely without weather. Yet storms rage there of greater scope and intensity than those down below in the troposphere. They have no clouds or rain, but radio men find them of great importance and call them magnetic or ionospheric storms.

Like all weather, magnetic storms come from the sun. Their "lightning" is called the *aurora* — aurora borealis in the Northern Hemisphere and aurora australis in the Southern Hemisphere. But a portion of the light in the sky at night anywhere is caused by a permanent auroral glow, proving that the entire atmosphere is subject to the same phenomenon that causes the northern and southern lights.

The auroral display is an atomic one, caused when streams of electrified particles



Present theories of the manner in which emanations from the sun cause auroral displays attribute most of the effects to high-velocity charged particles from regions at or near sunspots. Often, however, some spots produce no effects, and sometimes a brilliant aurora occurs which cannot be directly correlated with any particular region of spot activity on the sun.

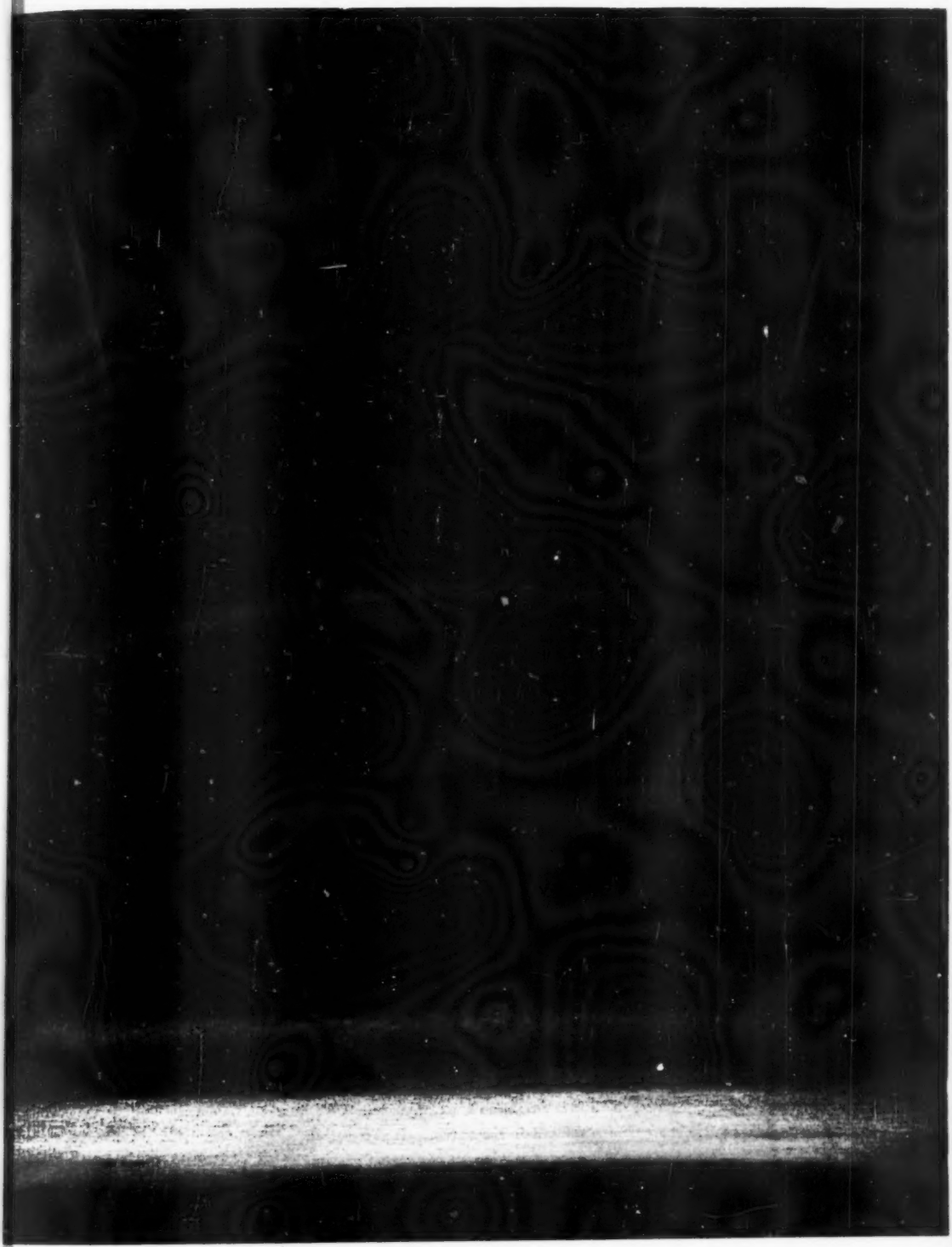
from the sun collide with the rarefied gases of the upper atmosphere. After consuming approximately 24 hours to traverse the 93 million miles between the sun and the earth, these particles are very much affected by the magnetic field of the earth. Instead of penetrating any part of the air, they flow toward the regions of the north and south magnetic poles. That is why the polar atmosphere, as it battles this storm of sun particles, frequently glows with auroral "lightning."

Every now and then Old Sol gets more energetic than usual and sends out tremendous additional quantities of radiation and electrified particles. At such times, usually directly after an active sunspot or a region of solar prominences has passed across the central region of the sun's disk, the auroral display is so pronounced it is seen over wide regions of the earth. It is then that radio communication over long distances is disrupted, for the charged layers of air in the ionosphere are distorted and no longer form good reflecting surfaces for radio energy. Predictions of changes in the ionospheric layers may often be made by observations of auroral displays, and conversely, poor short-wave radio communication may mean that an aurora brighter than usual can be seen.

Because nothing happens in a nothingness, the auroral lights show that there is atmosphere at great heights, even if it is practically a vacuum. Auroral measurements made in Norway thus prove the presence of tangible atmosphere 600 miles above the earth's surface.

The next time you see an aurora — and this year should provide many opportunities since we are just passing the maximum of sunspot activity — don't let its weirdness frighten you. Our atmosphere is thereby giving evidence of its continuous ability to protect us. The aurora-causing particles themselves are harmless, but other radiations from the sun, such as the extreme ultraviolet, are also screened out by the atmosphere. If all the sun's energy were to reach the earth's surface life could not exist here; the atmospheric filter lets through just the right amount of sun energy to make our lives possible and comfortable.

Starting at the horizon, the auroral drawing on the facing page depicts a homogeneous band, and above this a homogeneous arc. The curled auroral draperies mingle with a rayed arc, which is surmounted by the isolated rays that may form when a rayed arc breaks up.



IMPRESSIONS BY THE AUTHOR OF AN AURORAL DISPLAY COMBINING MANY DISTINCTIVE FORMS.

Amateur Weathermen of America

Amateur Weathermen of America comprises an association of all followers of the ways of the weather. Its purpose is to enlarge our understanding of weather and climate and to apply this information for the greater enjoyment of life. The Amateur Weathermen is an agency for the exchange of information, both technical and popular, among all interested individuals and groups. It is especially concerned with all projects that will enlarge the scientific outlook of the youth of America. All who enjoy studying any aspect of weather phenomena are eligible for membership and participation in its activities. Write to David M. Ludlum, Director, AWA, Franklin Institute, Philadelphia 3, Pa.

SEASONAL PROJECTS

Each season of 1948 will see AWA members throughout the country engaged in a particular study project. In spring and fall frost will be the subject. Snowfall and snowflake formation will come under scrutiny in the winter. And in the summer it will be thunderstorms. Convenient penny postcards are furnished all those interested in assisting. Observers mail these to headquarters at The Franklin Institute, where the data is analyzed and published in special bulletins.

BRITISH WEATHER

The popular publication of the Royal Meteorological Society, *Weather*, has entered its third volume. Much material of interest to AWA members will be found in its pages. Subscription for 12 issues is $3.60. Orders may be placed through the Book Service, American Meteorological Society, 5 Joy Street, Boston 8, Mass.

AWA ON THE AIR

AWA members in northern Jersey can now tune in at breakfast time and hear their past president explain the ways and wiles of the weather. Frank Romaine is on WRNJ six times a week at 7:45 a.m. with an informal discussion of the weather map.

PITTSBURGH AMATEURS

The Amateur Weathermen of Pittsburgh have been publishing an informative little bulletin since April, 1947. The *Weather Vane* contains announcements of the AWP, as well as local climatological data and instructive material on meteorology in general.

COURSE

A series of 12 lectures on elementary meteorology is being given this winter at The Franklin Institute. Many new audio-visual teaching aids such as sound pictures, charts, globes, and three-dimensional models are utilized to enliven the material. Herman Newstein, forecaster at the Philadelphia Southwest Airport, is the instructor. Outlines of the course are available for other AWA groups who wish to conduct a similar activity.

AMS MEETING

The 97th national meeting of the American Meteorological Society is being held in New York City, January 28-30, 1948. There is scheduled a joint session with the Institute of Aeronautical Sciences on Wednesday, the 28th, and AMS sessions on Thursday and Friday, the 29th and 30th. The annual business meeting takes place on Thursday afternoon.

CORRESPONDENCE COURSES

AWA members may now study weather at home in their leisure hours. The Pennsylvania State College has established four courses designed to serve as an introduction to the field of meteorology. For complete details write: Mineral Industries Extension Services, Pennsylvania State College, State College, Pa.

WEATHER 6-1212

The number of calls on the automatic weather telephone in New York City has doubled since 1941. In the single month of August, 1947, 1,799,182 calls were received from weatherwise vacationists. This was the peak for the year, but most months averaged nearly 1,200,000 calls.

WORLD WEATHER

The meteorology department of the University of Chicago is a small United Nations. In addition to 28 Air Force students, and 10 Filipino students who will be the nucleus of their national weather service, there are five army and navy officers from Argentina, and eight from other Latin-American countries. From Asia there are four Chinese, two from Pakistan, and one from Burma. There are two Egyptian students.

Here's an eye-opener for your weather eye!

techniques of observing the weather

By BENARTHUR C. HAYNES,
Chief, Observation Section,
U. S. Weather Bureau

Techniques of Observing the Weather by Mr. Haynes answers the crying need for a practical basic book on meteorology. He treats means and methods of observation thoroughly, giving detailed instructions on the use of instruments, charts, and forms. Techniques are clearly presented.

Mr. Haynes was Admiral Byrd's Weather Bureau meteorologist attached to the recent Navy Operation *Highjump*. He has been head of the Meteorology Department of the Boeing School of Aeronautics, Air Safety Specialist in Meteorology with the Civil Aeronautics Board, and in charge of Weather Analysis and Forecasting at the Army's Weather School, AAF, Technical Training Command. The results of his wide experience have been packed into *Techniques of Observing the Weather*.

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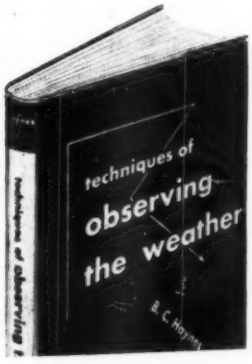
Dec. 1947 272 Pages $4.00



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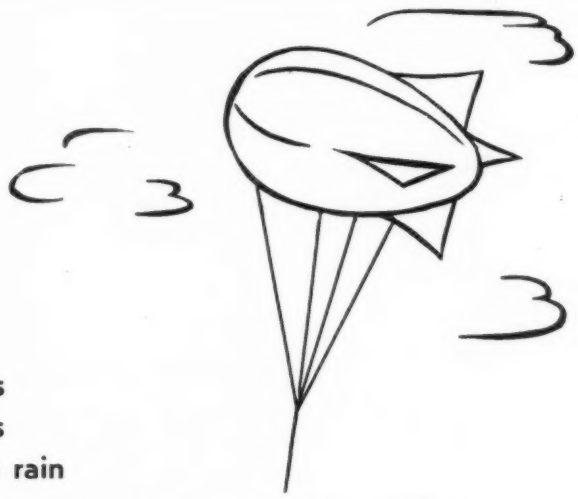

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WORKSHOP FOR WEATHERMEN

CONDUCTED BY CHARLES A. LAIRD

How to Construct an "Airways" Instrument Shelter

AN IMPORTANT PART of Weather Bureau equipment is the white shuttered instrument shelter. Amateur weathermen can build their own shelters. The accompanying diagrams show details of an "airways" shelter (Fig. 1a), which can be constructed without an elaborate outlay of tools and materials.

Dimensions are suggested, but the builder can alter these to fit the instruments he wants

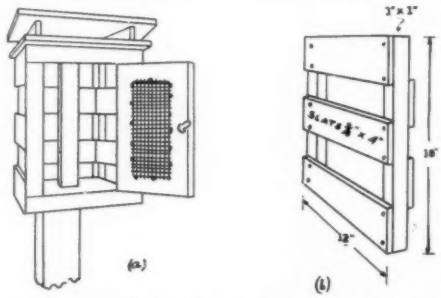

Fig. 1: At the left is the finished instrument shelter; at the right, the details of the wall construction.

to put into the shelter and the material at hand. Instead of louvers, ventilation is secured by alternating slats on the inside and the outside of the four upright corner posts (Fig. 1b).

Figure 1a shows how four pieces are fitted together into a door frame. The door is similarly constructed. Its opening is covered with coarse screen wire or hardware cloth, tacked on the inside. Dime store hinges may be used, and the latch can be a small hasp. The door frame is nailed to the front corner posts. The bottom (floor), made of 12" x 12" plywood, is nailed from the under side.

A double roof is used, the air space in between acting as insulation against direct rays of the sun. The two slanting pieces, separating the top roof from the under roof (ceiling), should be nailed to the under roof from the under side, as shown in Figs. 1a and 2a. The under roof should then be nailed on; then the top roof fastened to the slanting pieces. If plywood is unobtainable, ordinary lumber may be substituted.

The thermometer may be mounted on an upright board, placed in the center of the shelter, as shown in Fig. 1a. The structure should be painted white, inside and out, because white best reflects the sun's rays.

Our shelter can also be made using old window shutters for sides and back. The slats should be fastened at about a 45-degree angle, so the sun at all times is kept off the instruments.

The "airways" shelter can be bolted to a post, which is set into the ground, forming a support with the shelter about five feet above ground. It should be mounted over sod, its door facing the north, and away from buildings so there is free circulation of air.

Another small structure, known as the cotton-region shelter, is used at some Weather Bureau stations. It is generally mounted on a wooden support, while the standard shelter requires a steel support. But it takes considerable skill and the use of mortising tools to fit the louvers (slats) into each side of the standard shelter. The amateur with a carpentry workshop who wishes to build the standard shelter may write to the United States Weather Bureau for detailed blueprints.

The standard instrument shelter usually houses thermometers showing the highest and lowest temperatures for a 24-hour period, a thermograph that makes a continuous record of temperatures, and a wet-and-dry-bulb thermometer to determine humidity. The latter is mounted on a stand at the right side of the shelter. The other two occupy a shelf on the left side. Amateur construction of some of these instruments will be described in later articles.

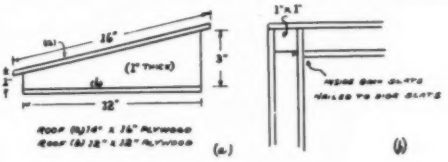

Fig. 2: At the left are details of the construction of the double roof; at the right, the method for joining the sides to the corner posts.

JUNE IN JANUARY

Miami mid-winter temperature averages 68°, which compares favorably with June in Boston (67°) or Chicago (68°). Nighttime lows in winter at Miami run generally a little above 60°, while June minima in Boston and Chicago average slightly under 60°. Daytime highs average near the mid-70's at all three points. And what was it that Lowell said, as he wrote about early summer in New England? — "What is so rare as a day in June. . . ."

Drought - October, 1947

WHILE THE DROUGHT during the autumn of 1947 was not of record duration in New England, it was definitely responsible for the extent of the destructive forest and brush fires that ravaged portions of all the New England states excepting Rhode Island. In the Mount Desert Island area of Maine, property damage was estimated at more than three million dollars, with the loss of five lives. The growing season had reached or passed its peak; therefore, crop damage from the prolonged dry spell was of smaller consequence, but pasture lands became prematurely dried up.

In Boston there was no measurable precipitation for a period of 28 days, October 1st through 28th, and only 0.06 of an inch occurred from September 23rd through October 28th. In addition to the practically complete lack of precipitation, the drought was intensified by unseasonably high temperatures and low humidities. Daily maximum temperatures were broken on the 17th with 89°; 18th, 82°; 23rd, 84°; and the 27th, 82°. Temperatures on the 17th, 23rd, and 27th were the highest that have ever occurred so late in the season. A relative humidity of 17% was noted at noon on October 22nd. Longer periods without precipitation were recorded in 1930, 29 days, September 9th through October 7th; 1915, 36 days, February 26th through April 2nd; 1924, 44 days, October 9th through November 21st.

In New England, the state precipitation average for the first 28 days of October, 1947, was Maine, 0.26 of an inch; New Hampshire, 0.24; Vermont, 0.25; Massachusetts, 0.06; Rhode Island, 0.05; Connecticut, 0.05. The average for the New England section as a whole was 0.15 of an inch. The record for the month of May, 1903, during a serious drought, was 0.68 of an inch average precipitation for the New England section. The effects of the October, 1947, drought were aggra-

(Continued on page 18)

A PICTURE IS WORTH 1000 WORDS. A MODEL IS WORTH 1000 PICTURES

Airology puts weather into three dimensions. The above is a model of a cold front. The U. S. Navy is using 9 sets of seven models each as visual aids in weather training. There is a set in the Willetts Memorial in the American Museum of Natural History.

AIROLOGY

175 Warner Avenue, Roslyn Heights, L. I., N. Y. Telephone Roslyn 1270.

FORECASTING THE WEATHER

Predicting Cold Waves

LYNN L. MEANS
U. S. WEATHER BUREAU, CHICAGO AIRPORT

COLD WAVE WARNINGS are important to just about every individual. Farmers, shippers, transportation and public utilities officials especially want to know about the possibility of cold waves before they occur. In the north-central states, where cold waves are frequent and where blizzards sometimes accompany the outbreak of continental polar or continental arctic air masses, accurate and timely warnings for all concerned may even mean the saving of life. Therefore, the Weather Bureau provides special warnings for cold waves.

In making his forecasts, the weatherman must consider weather patterns not only over North America but over as much of the Northern Hemisphere as possible. The North Atlantic is watched for "slowing down" tendencies which seem to move westward, while the western Pacific is watched for major wave cyclones that develop in the vicinity of Japan and move eastward. Both the sea-level and upper-air patterns provide much information. But closer to home, here are some of the basic weather factors concerning a cold wave over a fairly large area in the north-central states.

First, a cold air mass must be present to the north or west. Twenty-four hours before a cold wave hits Chicago, the cold air mass may already have moved into the Dakotas or Minnesota; while 48 hours before, the cold air may be entirely north of the Canadian border. In identifying cold air masses north of the border, one must keep in mind that normal mid-winter minimum temperatures in Manitoba and Saskatchewan are slightly below zero and in Alberta only slightly above zero. For the development of a genuine cold wave, below normal temperatures should be observed in these areas.

On the surface weather map, an intense low moves eastward or northeastward across or near the Great Lakes region and a high-pressure area which is present over the Yukon or Mackenzie basin begins moving southward. The timing of the cold wave will depend to a very marked degree upon the accurate forecasting of the intensity and movement of the low. The arctic or polar cold front moves rapidly southward east of the Rockies as cold air drains out of Canada to the rear of the low. Cold waves rarely occur to the rear of a slow-moving low-pressure system. The central pressure of the high or of the low is not so important as a large difference in the two central pressures, which is associated with a larger mass movement of air. Pressure changes are watched closely for the direction of movement of the preceding low and for indications of movement of the Canadian high. The northerly winds to the rear of the cold front are observed for any veering to an easterly direction, for if these winds become easterly the cold front slows down and the cold-wave danger diminishes.

Upper-air patterns usually show a ridge of high pressure over the Pacific Coast 24 hours prior to the cold wave, with a major trough that extends across a large latitudinal band located in the central United States and moving eastward.

Some factors assist the rapid temperature changes in a given area. Cloudy skies during the first day following the cold front passage will tend to block the warming effect of the sun, then a clear night, with a large loss of heat to space through the dry cold air mass, will give low temperatures. Snow cover has an effect similar to that of cloudiness during the day, for sunlight is reflected from the snow surface instead of being absorbed by the ground.

Many factors suppress the full effect of the cold wave. Clear skies during the day with clouds at night tend to trap and hold heat. The relatively warm waters of the Great Lakes affect the temperature drop on the east and south lake shores. The lakes also contribute heat and moisture for the formation of stratocumulus clouds in the turbulent cold air masses and these modify the nighttime temperature drop in areas downstream from the lakes. Excessively high temperatures in the warm air mass ahead of the cold front may also be a modifying factor.

Once the cold wave has arrived, it may prove to be a "quickie," lasting only two or three days, or it may hold on for two weeks depending upon whether the ridge aloft on the West Coast flattens out or persists. "Quickies" are much more frequent than the longer cold spells, with warming occurring sometimes as rapidly as the cooling had originally taken place.

Rapid drops in temperature to very low values such as characterize genuine cold waves are experienced at Chicago on the average of only two or three times each winter. In eastern North Dakota and northern Minnesota the frequency is several times as great. But large temperature drops are not unusual in winter in any part of the Middle West. On January 27, 1934, the maximum temperature at Chicago was 49°; the next day the minimum thermometer read zero.

The Weather Bureau definition of a cold wave in Chicago is a drop of 20 degrees or more within 24 hours to 20° or less for the period March 16th to November 15th; or to a low of 10° or less from November 16th to December 15th, and February 16th to March 15th; and to a low of 5° or less for December 16th to February 15th.

The lowest temperature ever recorded in Chicago was 23° below zero on December 24, 1872. The longest period with the daily minimum below zero was from January 4 to 13, 1912.

TECHNIQUES OF OBSERVING THE WEATHER

B. C. Haynes. John Wiley & Sons, Inc., New York, 1947. 272 pages, 98 ills. $4.00.

THIS excellent little book will be a welcome addition to the amateur weatherman's book shelf. In the introductory chapter the reader is presented with a series of concise paragraphs reviewing elementary definitions as well as the structure and general behavior of the atmosphere. The second chapter discusses the selection of a station site and the arrangement of instruments; examples of various station-log forms are shown.

Chapters III to XII contain definitions of meteorological elements and a descriptive survey of equipment and methods employed in observing the weather. The headings of these chapters read: Clouds, Visibility, Hydrometeors, Temperature, Humidity, Wind, Pressure, Precipitation, Winds-Aloft Observation, Electronic Meteorological Observations. Considerable emphasis is placed on the discussion of clouds, and their various types and formations are described in detail according to the international classification.

The last chapter, "An Improvised Weather Station," which was adopted from notes by the Army Air Forces Technical Training Command, will appeal particularly to the weather hobbyist. Here, the author presents simple designs for weather instruments which can be built with the few tools and materials readily available in any household. The directions and illustrations for constructing and calibrating various meteorological measuring devices are both instructive and stimulating and contain the promise of many an enjoyable hour at the workbench.

The references and bibliography occupy pages 197 to 205, the bibliography being subdivided into the subjects of the main chapters. The selection of pertinent literature is confined to articles and books written in English.

In the remaining pages an extensive appendix can be found, which contains useful conversion tables and psychrometric tables, as well as instructions for reducing barometric pressure to sea level. In addition, work sheets, questions, and weather-record forms facilitate home study.

In general, this book will not only serve the amateur weatherman, but may also be advantageously used as a handy reference by the novice professional weather observer. The science teacher in high school, too, may find this text a valuable aid in taking up the study of weather. Even the college teacher of an elementary or cultural course in meteorology may recommend this text as supplementary reading to his students.

The volume bears the stamp of authority, as it is written by a staff member of the U. S. Weather Bureau who is well known to ground school instructors and private pilots of the prewar period through his book "Meteorology for Pilots." The author's style makes, in general, for pleasant and relatively easy reading, though there are a few awkward phrases here and there. The chapters are well illustrated and balanced, and the few obvious slips in the text do not materially detract from the general value of the book. In a future edition, explanations of some terms, such as "superregenerative and superheterodyne," "potentiometer," and so forth, and missing references in the text to illustrations and various items on them, may perhaps be added for the benefit of the lay reader.

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EXPERIMENTS WITH CLOUDY SKIES

(Continued from page 5)

ported in sufficient detail to permit analysis.

What the future holds is not easy to predict. Caution must be exercised in analyzing experiments of this kind. It should be remembered that natural processes generally produce precipitation when suitable cloud systems occur. Much careful study of naturally occurring precipitation must be made to differentiate properly between natural and artificial effects that develop in the free atmosphere. Because of the vast areas involved, new observational techniques must be developed and mastered if a worthwhile evaluation is to be realized.

As in many others of the natural sciences, significant advances in various phases of meteorology are now occurring in rapid sequence. All of us are indeed fortunate to be in a position to observe and perhaps assist in some of these fascinating activities.

DROUGHT — OCTOBER, 1947

(Continued from page 16)

vated because precipitation had been approximately 50 per cent below normal in most of the New England states during August and September, as indicated by the following figures:

	August	September	October
Maine	−1.87	−1.12	−3.16
New Hampshire	−1.89	−1.67	−2.39
Vermont	−0.93	−1.80	−2.13
Massachusetts	−1.51	−0.50	−1.58
Rhode Island	−1.83	−0.20	−0.37
Connecticut	−1.09	−0.64	−1.42